

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A method of processing an electronic assembly, comprising:
capturing an image of a contact formation on a surface of a semiconductor package,
wherein the contact formation has a surface comprising a first area and a second area, where
in the first area is a normal brightness area and the second area is a dull brightness area, the
image having a width and ~~a captured contact point corresponding to an actual contact point~~
~~on the contact formation and comprising~~ a plurality of pixels, the pixels having side lengths
of at least 20 percent of the width of the image;
selecting pixels from the plurality of pixels, wherein the selected pixels have a
minimum threshold of normal brightness area;
approximating a contact formation shape and location based upon the shape of the
pattern of selected pixels;
calculating a center of the approximated contact formation shape and location, which
corresponds to a captured contact point corresponding to an actual contact point on the
contact formation; and
placing the semiconductor package on a circuit board having a socket such that the
actual contact point is in a selected position relative to the socket.

2. (Original) The method of claim 1, further comprising picking the semiconductor package from a support.
3. (Original) The method of claim 2, further comprising suspending the surface of the semiconductor package within a field of view of the camera.
4. (Original) The method of claim 3, wherein the image is captured with a CCD camera.
5. (Currently Amended) The method of claim 1 ~~claim 4~~, wherein the approximating of the contact formation shape and location and the calculating of the center of the contact formation center comprises the use of a computer ~~has a surface comprising a first area and a second area.~~
6. (Currently Amended) The method of claim 5, wherein the contact formation shape approximates a circle ~~where in the first area is a normal brightness area and the second area is a dull brightness area.~~
7. (Currently Amended) The method of claim 1 ~~claim 6~~, wherein the captured image includes only the normal brightness area of the outer surface of the contact formation.
8. (Original) The method of claim 7, wherein the contact formation has an outer edge and an actual center.

9. (Original) The method of claim 8, further comprising defining an outer edge of the captured image and determining a captured image center.
10. (Currently Amended) The method of claim 5 ~~claim 9~~, wherein the approximating of the contact formation shape and location further comprises using data provided to the computer of an expected size and shape ~~captured image center corresponds to the actual center~~ of the contact formation.
11. (Currently Amended) The method of claim 6 ~~claim 10~~, wherein the contact formation is substantially spherical.
12. (Original) The method of claim 11, wherein there are a plurality of contact formations on the surface of the semiconductor package.
13. (Original) The method of claim 12, wherein the contact formations are BGA solder balls.
14. (Original) The method of claim 13, wherein the contact formation has a diameter of approximately 0.55 mm.
15. (Currently Amended) The method of claim 1 ~~claim 14~~, wherein the semiconductor package is a microprocessor.
16. (Original) The method of claim 15, wherein the circuit board is a motherboard.

17. (Currently Amended) The method of claim 1 ~~claim 16~~, wherein the socket has a plurality of conductor pads formed therein and when the semiconductor package is placed within the socket, the actual contact point of each contact formation contacts a conductor pad in the socket.

18. (Currently Amended) A method of processing an electronic assembly, comprising:
capturing an image of a contact formation on a surface of a semiconductor package with a CCD camera having a plurality of pixels, the semiconductor package including a microelectronic die with an integrated circuit formed therein, the contact formation having a surface with an actual contact point, the image having a diameter five or less times the length of a pixel of the plurality of pixels of the CCD camera ~~an captured contact point~~
~~corresponding to the actual contact point on the outer surface;~~
selecting pixels from the plurality of pixels, wherein the selected pixels have a minimum threshold of normal brightness area;
approximating a contact formation shape and location based upon the shape of the pattern of selected pixels;
calculating a center of the approximated contact formation shape and location, which corresponds to a captured contact point corresponding to an actual contact point on the contact formation; and
placing the semiconductor package on a circuit board having a socket such that the actual contact point is in a selected position relative to the socket.

19. (Original) The method of claim 18, wherein the actual contact point is an actual center of the contact formation and the captured contact point is a captured center of the image.

20. (Original) The method of claim 19, wherein the semiconductor package is a microprocessor and the circuit board is a motherboard.

21. (Currently Amended) A method of processing a semiconductor package, comprising:
picking a microprocessor from a support, the microprocessor having a bottom surface with a plurality of contact formations formed thereon and including a microelectronic die with an integrated circuit formed therein, the contact formations being substantially spherical, each having a surface and being electrically connected to the integrated circuit, the surface having an actual center, a normal brightness, area, and a dull brightness area;

suspending the bottom surface of the microprocessor within a field a view of a CCD camera;

capturing an image of the normal brightness area of at least one of the contact formations with the CCD camera, the image having a width ~~and a captured center~~ and comprising a plurality of pixels, ~~the captured center corresponding to the actual center~~, the pixels being square with sides of at least 20 percent of the width of the image;

selecting pixels from the plurality of pixels, wherein the selected pixels have a minimum threshold of normal brightness area;

approximating a contact formation shape and location based upon the shape of the pattern of selected pixels;

calculating a center of the approximated contact formation shape and location, which corresponds to a captured contact point corresponding to an actual center of the contact formation; and

placing the microprocessor in a socket on a motherboard, the socket with a plurality of conductor pads formed therein, so that the actual center of each contact formation contacts a conductor pad within the socket and the integrated circuit is electrically connected to the conductor pads.

22. (Original) The method of claim 21, wherein the support is a reel with an adhesive tape attached thereto.

23. (Original) The method of claim 22, wherein the contact formations are BGA solder balls.

24. (Currently Amended) An apparatus for processing electronic assemblies, comprising:
a frame;

a semiconductor package support secured to the frame to support a semiconductor package, the semiconductor package having a surface with a contact formation thereon and including a microelectronic die with an integrated circuit formed therein;

a CCD camera, having a field of view, connected to the frame to capture an image of the contact formation;

a computer in communication with and coordinating the actions of the CCD camera and the pick-and-place head;

a machine readable medium having instructions comprising:

selecting pixels from the plurality of pixels, wherein the selected pixels have a minimum threshold of normal brightness area;

approximating a contact formation shape and location based upon the shape of the pattern of selected pixels; and

calculating a center of the approximated contact formation shape and location, which corresponds to a captured contact point corresponding to an actual contact point on the contact formation;

a printed circuit board support secured to the frame to support a printed circuit board, the printed circuit board having a socket; and

a pick-and-place head connected to the frame for movement to pick the semiconductor package from the semiconductor package support, suspend the semiconductor package so that the surface of the semiconductor package is in the field of view of the CCD camera, and place the semiconductor package in the socket on the printed circuit board.

25. (Original) The apparatus of claim 24, wherein the CCD camera has a focal length and the pick-and-place head is connected to the frame such that it suspends the semiconductor package in the field of view of the CCD camera so that the surface of the semiconductor package is at the focal length of the CCD camera.

26. (Original) The apparatus of claim 25, wherein the support comprises an adhesive tape attached to a reel.

27. (Original) The apparatus of claim 26, wherein the circuit board is a motherboard.

28. (Currently Amended) The apparatus of claim 24, wherein the instructions on the machine readable medium further comprises instructions for using data comprising expected sizes and shapes of contact formations ~~claim 27, further comprising a computer in communication with communication with and coordinating the actions of the CCD camera and the pick and place head.~~